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Research and Development

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Project Summary

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Portable Miniature Sampler for Potential Airborne Carcinogens in Microenvironments: Phase 2. Evaluation

D. S. West, F. N. Hodgson, J. J. Brooks, C. L. Heflin, T. W. Hughes, and C. R. McMillin

The collection, concentration and analysis of a broad range of organic compounds from ambient air has been a challenging problem for environmental researchers for a long time. Problems with measuring organic pollutants in ambient air include specificity to individual compounds, detection limits for ambient co-concentrations, cumbersome size of sampling equipment, complexity of analysis, artifact formation in the sampling and analysis protocols, and costs associated with data generation. A portable sampling system has been developed for ambient air levels of organic contaminants. The system utilizes a combination of solid sorbents for sample collection and GC/MS analysis to solve the problems associated with ambient air measurements for organics.

This Project Summary was developed by EPA's Environmental Sciences Research Laboratory, Research Triangle Park, NC, to announce key findings of the research project that is fully documented in a separate report of the same title (see Project Report ordering information at back).

Overview

A portable sampling system was developed for the collection and concentration of a broad range of organic compounds from ambient air. The system is based on the use of three solid sorbent materials, Tenax-GC, Porapak R, and Ambersorb XE-340 arranged in series, through which air is drawn by a portable battery-powered pump. Two different portable pumps, DuPont P4000 and Spectrex PAS 3000, were used to power the portable sampling device in field evaluations of the system.

The system was evaluated in field studies conducted in Dayton, Ohio; Los Angeles, California; Houston, Texas; Niagara Falls, New York; Research Triangle Park, North Carolina; and Cincinnati, Ohio. Both indoor and outdoor environments were included among those sampled. Analyses were conducted for selected target compounds as well as additional broad-scan qualitative analyses of collected organic compounds. Analyses of the samples were accomplished using thermal desorption of the sorbent materials followed by capillary column gas chromatography/mass spec-

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trometry (GC/MS). Partial pre-analysis fractionation (based primarily on volatility) was obtained in some of the sampling applications, demonstrating that in certain environments additional capacity beyond that of Tenax-GC may be required to sample low level organic atmospheric pollutants.

System Description

The general population, particularly in urban areas, is exposed to a wide variety of atmospheric pollutants. Currently, the health hazard posed by this situation cannot be adequately defined because of the complexity of the problem and the lack of sufficient, reliable data. One of the needs in assessing this exposure problem is a reliable screening technique for determining what substances at what concentrations are present in our ambient atmosphere.

The ability to assess the extent of a health hazard in ambient air requires at least three things:

1. knowledge of the materials that pose the hazard,
2. a reliable sampling technique for collecting these materials, and
3. adequate technology for accurate analyses of these materials.

The objective of this research program was to develop a portable miniature collection system that could be used to assess the exposure of an individual to atmospheric pollutants, especially those pollutants that potentially threaten the health of the individual. Since a wide variety of gases, vapors, and particulates of organic compounds, ranging from volatile hydrocarbons (e.g., methane) to high molecular weight phthalates (plasticizers), polychlorinated biphenyl pesticides, and polynuclear aromatics, are present as pollutants within the atmosphere, the collection system was to be capable of concentrating a wide variety of organic compound vapors from ambient air. A number of organic compounds suspected of being carcinogens, mutagens, cofactors, or precursors, and therefore of environmental and health concern, was to be selected for specific evaluation.

Procedure

A three-sorbent, portable sample collection system was designed, evaluated, and field tested in Dayton. The sorbents were operated in series, drawing air in turn through Tenax-GC, Porapak R, and Ambersorb XE-340 using a small personal pump. This selection of sorbent materials was judged the best combination of commercially-available sorbents for broad-range organics sampling. Two types of small personal pumps, DuPont Model P-4000 and Spectrex Model PAS-3000, were used to collect samples during these field evaluations.

The result of this research is a sampling system and associated analytical methodology that is capable of screening for a broad range of organic components in ambient air and, in particular, for assessing the presence or absence of the selected potential carcinogenic compounds. This study represents a step toward a reliable approach for assessing the health hazard to an individual posed by potentially carcinogenic materials in ambient air.

Results

In terms of concentrating organic compounds on the sorbent materials, the portable sampling system operated as anticipated in field sampling applications. The need for additional, complementary sorbent capabilities besides those of Tenax was demonstrated in the Los Angeles and Houston samples where significant amounts of organics were observed on the subsequent (Porapak and Ambersorb) tubes. A partial fractionation was also observed on the various sorbent materials where different ranges of compounds (based primarily on volatility) were found. Some influence appears to be exerted by matrix and humidity effects on the amount of breakthrough observed on the latter sorbents. The Niagara Falls and Research Triangle Park samples were collected in an interior environment and exhibited little if any compound breakthrough compared to the Porapak and Ambersorb materials. Figures 1, 2 and 3 represent the portable sampling system.

The analytical methodology is based primarily on capillary column GC/MS using thermal desorption for recovering the sample from the sorbents for analysis. Samples collected in high humidity environments (e.g., Houston) caused particular problems in the analysis phase due to high concentrations of water collected on the Porapak and Ambersorb sorbents. However, researchers found that by changing certain analytical parameters (e.g., initial GC temperature), a satisfactory analysis could be performed in these instances.

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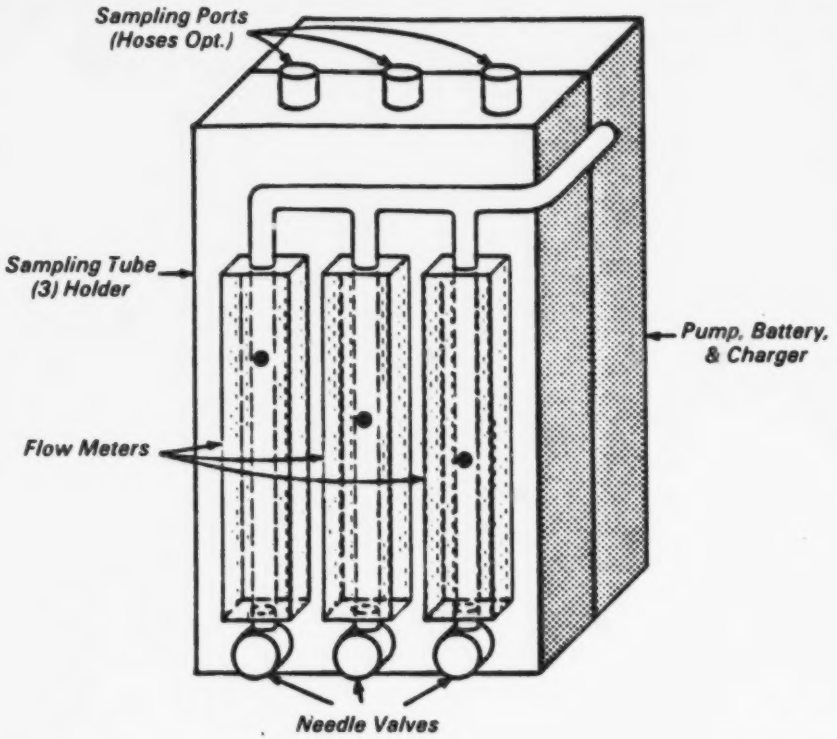

Weight	- 2.3 kg (< 5 lb)
Cost	- $635 for DuPont P4000-A (pump, battery and charger only)
Operational time	- ≥ 8 h
Method of setting flow	- Needle valves and small flow meters
Durability problems	- Needle valves fragile and pump near maximum for long periods

Figure 1. Sketch and description of a small personal sampler.

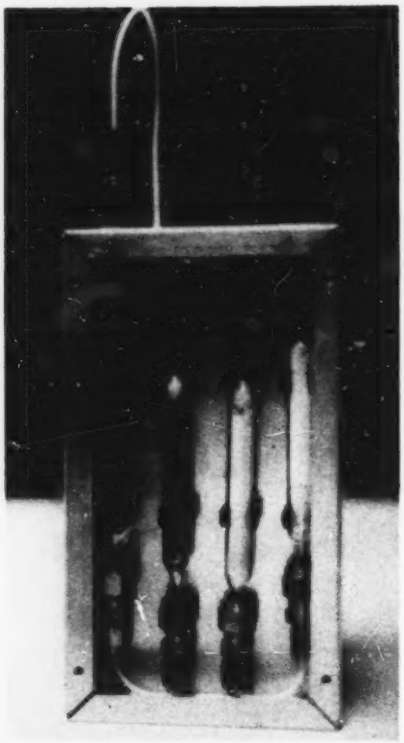

Figure 2. The "tube tray" portion of the Ambient Air Collection System.

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Figure 3. *Portable Miniature Collection System.*

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The complete report, entitled "Portable Miniature Sampler for Potential Airborne Carcinogens in Microenvironments: Phase 2. Evaluation," (Order No. PB 82-129 461; Cost: $18.00, subject to change) will be available only from:
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